I. P. Sharp Associates

IPSANET

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Printed in Canada
March 1984
Publication Code: 0239 8403 E1

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2. DESCRIPTION

2.1 BENEFITS OF IPSANET

Local access to the mainframe computers of the I.P. Sharp timesharing or distributed systems is available via IPSANET, I.P. Sharp's own communications network, from Canada, United States, Europe, Australia, Hong Kong and Singapore. In 1973, I.P. Sharp introduced its own internally developed packet-switching network in Europe, and later, worldwide. Today the network is one of the largest and most advanced in the world.

IPSANET brings significant and unrivalled benefits:

High Reliability: Communications failures are much less frequent than with conventional multiplexing networks. Users are kept informed of the status of their connection to the mainframe system. For all cases where multiple routes through the network exist, the best route is automatically selected. The network is monitored 24 hours daily, every day.

Simple Enrolment: User enrolment is simple, rapid and universal. Once an account number has been issued authorising access to a SHARP APL system, it can be immediately used at any access point on the network worldwide. There is no formality or billing procedure to be negotiated locally in each country from which access is required. There are no installation costs for users accessing by dial-up services.

Simple to Use: The sign-on procedure is reduced to a very simple form which is the same everywhere, and you have all the advantages of working with a single vendor which is providing the total service.

Local Support: Local advice and assistance is available through any of the many I.P. Sharp branch offices.

Fast Response: The network is optimised for interactive use.

Error-Free Transmission: Transmission errors are automatically detected and corrected by the network.

Terminal Flexibility: Terminals of many types and speeds are supported.

Low Connect Charges: There is no connect charge for access to distributed systems. Connect charges for timesharing are low (approximately $1.00/hour) whether you're located in Brussels, Sydney, Toronto or New York. In addition, the large number of local access locations reduces telephone costs to users.

Cost Effective: The cost of use is very competitive with public data networks with their additional overheads inevitable with a generalized service. For many users, IPSANET is a very much cheaper alternative to dedicated lines.

At present, the network contains some 180 communications computers, called **nodes**, that are linked together providing a continuous network that includes most major cities (see Figure 1). Many nodes are installed on customer premises, both at distributed system data centres and at remote branch

offices, thus providing the same level of service to distributed system users as is available to timesharing customers.

The network also interconnects directly with many major public data networks including Datapac, Datex-P, PSS, Telenet, Telepac, Transpac and Tymnet. Through the local access cities of these networks, together with their interconnections to other public data networks throughout the world, access is provided by a local phone call in more than 600 places in 46 countries. The interconnection with the Telex network provides a means of access from any other location not served by IPSANET or public data networks.

ASCII asynchronous terminals, including personal computers, word processors and similar equipment, are supported at all access points on the network. In addition, nodes can be configured to support IBM EBCD or correspondence terminals, IBM 3270 series Information Display Systems, bisync devices emulating 2780 or 3780 protocols, lineprinters and magnetic tape drives. The network also provides for data transfer between the I.P. Sharp data centre and distributed system sites.

As the network is dedicated to the I.P. Sharp user, all user enrolment and usage totalling is performed by the timesharing or distributed system. Therefore no special enrolment for the network is required, and no special billing procedure. Anyone with any suitable terminal, who is authorised to access a system attached to the network, can immediately communicate with that system from any access point, anywhere in the world without any further formality. When you connect to the network, your first entry consists of three to eight characters, including the carriage return, and this serves to identify the terminal details (type, character set and speed), the system you wish to access, and also causes a call to that system to be set up. The call will be set up by the best route available at the time of the call, and does not depend on a pre-determined routing specified by means of configuration parameters.

The network itself is highly reliable, and is continuously monitored, so that faults are rapidly detected and corrected. There are many alternative routes through the network, and should the preferred route for a call fail, then there is often a back-up route immediately available. Error rates on all network links are monitored, which often provides early warning of imminent link failures and allows corrective action to be taken before service is interrupted.

Figure 1
IPSANET

2.2 HOW THE NETWORK OPERATES

Computer Hardware and Software

Two types of computer hardware are used for the network nodes. IBM 3705 communications controllers, or similar, are the nodes adjacent to distributed systems, and perform the front-end processor functions. To the mainframes, they appear identical to a 3705 running the IBM Emulator Program. In addition to supporting direct attachment of asynchronous terminals, the IPSANET Emulator Program (IEP) performs all IPSANET functions such as link management and call routing. The majority of nodes located throughout the world are Computer Automation Alpha 2/20 or 2/40 minicomputers, which in addition to the network functions can also be configured to support asynchronous or 3270 terminals, bisync devices, X25 interfaces to other networks, and direct attachment of peripherals.

Elements of Packet-Switching

All messages sent between the mainframe and a terminal are transmitted as one or more variable-length **packets**, each containing destination and error-checking information. As it travels through the network, a packet is checked at each node. If an error is detected, then retransmission is requested, resulting in virtually error-free transmission. The network packet length is optimised to give fast response to the short messages which arise in interactive systems.

Line Utilization

The link protocol which controls the data flow beween nodes was developed by I.P. Sharp to provide the greatest efficiency and fastest response. The efficient line utilization is based on statistical multiplexing. Advantage is taken of the fact that not all terminals connected to the network operate simultaneously at full speed. This makes possible the relatively low connect charges. In conventional networks, a fixed bandwidth must be allocated for the duration of the terminal connection. Packet-switching networks can achieve very high line utilization by freeing communication resources when they are not actually being used by a terminal, (i.e., when the user is thinking and no characters are being sent). At times of overload, the network is protected by flow control in both directions, and the data already in the network is queued within the nodes until a transmission slot becomes available. To the user, this appears as slight inter-packet pauses.

Node Intelligence

A high degree of intelligence is built into the nodes. Line 'hits' or failures will not result in disconnection of the user from the mainframe system if the line recovers within 15 seconds. The nodes are able at all times to reply to users, keeping them aware of the status of their connection. In addition, the network is able to recognise automatically and adapt to the type and speed of the terminal being used.

Nodes can be installed anywhere where several terminals are used concurrently, resulting in reduced dial costs and reduced error rates on local telephone lines. Terminals can be connected directly to the node eliminating the need for modems.

Operational Convenience

The operational simplicity of IPSANET is a major factor in its reliability. Essentially the whole of the network can be controlled and managed from any location. Nodes may be configured and restarted without interrupting the operation of other nodes. An error-tracing facility also allows the software in one node to be inspected and modified remotely from another. The **down line**

load capability means that nodes are always loaded with the latest version of software from the central system through the network. This, coupled with the intrinsic reliability of the Alpha hardware, enables completely unattended operation of the nodes except when physical maintenance is required.

Enhancement Capability

The software in both the 3705 and Alpha nodes is developed and maintained by I.P. Sharp, thus ensuring that it is optimised for this network. This allows I.P. Sharp to have complete control over the process of continuous evolution, where new features can be added as required to meet the changing demands of network users. Changes and enhancements are always introduced in a compatible way, with the result that the whole network never has to be shut down for a new configuration or software release to be installed. The network has been in continuous operation without a single shutdown since 1976.

Network Maintenance

Each node continuously monitors its own status and the status of the lines connecting it to its neighbour nodes. At regular intervals the node reports its status through the network logging system; a report is dispatched immediately if an important event occurs such as the inability of a network link to pass data for longer than 15 seconds. These logging reports are all collected by a central SHARP APL system which maintains a complete database of network status. This same SHARP APL system also contains the databases of node software and configuration tables, controls the down line load operation, and provides a large number of network analysis tools for the communications personnel. This SHARP APL system is accessible from anywhere on the network and therefore allows the communications personnel equal access independent of their geographical location.

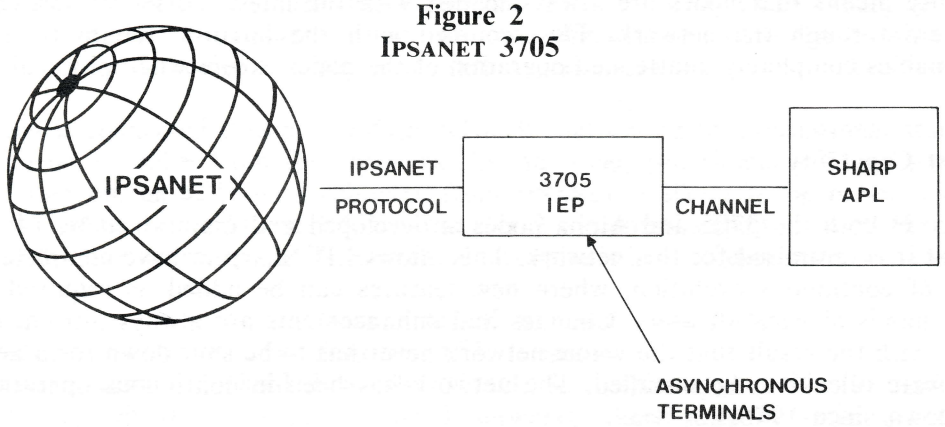
2.3 HOW TO CONNECT TO THE NETWORK

2.3.1 Connecting a Distributed SHARP APL MVS or VSE System

SHARP APL systems providing service to multiple users can be connected to IPSANET as host computers which are accessible from any network node. In addition to the service this offers to users of that system, the accessibility of the SHARP APL system means that I.P. Sharp's support for the APL system itself is much more responsive and direct. There are two methods of connection of host systems, and in both cases one or more dedicated lines between the system and the nearest access point on IPSANET is required.

The most versatile method, offering the greatest efficiency, best performance and closest integration of IPSANET with the SHARP APL system is by means of a 3705 with IEP (IPSANET Emulator Program software), shown in Figure 2.

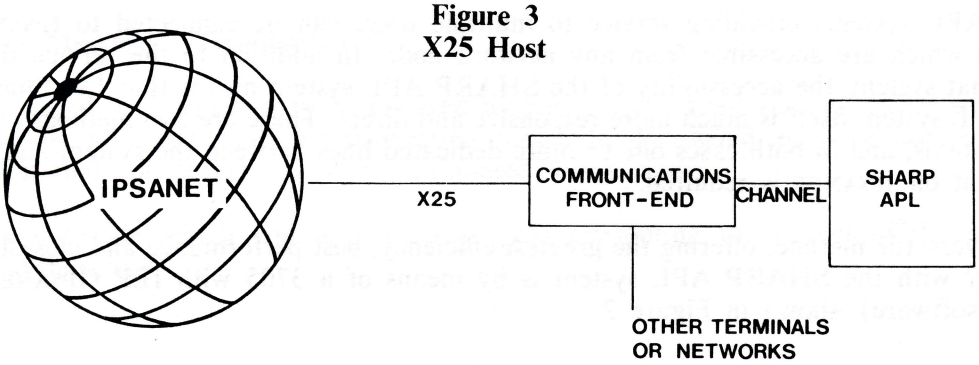
Figure 2
IPSANET 3705



This is the most cost effective solution for larger APL systems: up to 150 simultaneous users can comfortably be supported through EPH and a single 3705. In addition to the remote users, local terminals, dial-up lines and multiplexers can be connected to asynchronous ports on the 3705. In addition to supporting asynchronous terminal users, the IEP 3705 also supports the R-task for file transfer. The IEP 3705 software cannot share the same 3705 as any IBM software such as NCP. The IPSANET 3705 hardware can be an IBM 3704, IBM 3705 or Amdahl 4705; a minimum memory of 64k bytes is required. Other requirements for the hardware configuration, such as channel adapter, communications scanner and clocks, are documented in the I.P. Sharp publication *SIN-26*. The IEP 3705 functions as a full IPSANET node, capable of setting up calls to remote hosts, routing traffic, driving multiple network links using IPSANET protocol, and so on. It can therefore act as the heart of a private sub-network, with multiple routes, and not just as an isolated spur. Furthermore, the network links terminating in the IPSANET 3705 can be included in the normal IPSANET network monitoring and diagnostic procedures.

An alternative interface is provided by connecting a line using X25 protocol from IPSANET directly to the front end processor or host system, as shown in in Figure 3.

Figure 3
X25 Host



The user software in the front end and host will determine exactly what types of terminal can be supported, whether synchronous or asynchronous. For example, an IBM 3725 or 3705 running NCP with the additional NPSI (Network Packet Switching Interface) software could be connected; this has the possibility of communicating with another IPSANET host system, or with 3274 cluster controllers or asynchronous ASCII terminals at remote locations on IPSANET, provided that the NCP program has been suitably configured to include the remote hosts and terminals. The IPSANET support of 3270 terminals uses a connection of this type. An alternative method of supporting 3270 terminals can be provided, an 'SDLC pipeline', using SDLC as the link protocol at both the terminal and the host ends.

A single host system may have more than one connection to IPSANET, perhaps of different types, providing additional reliability and functionality. For example, part of the bandwidth of the link to IPSANET could use IPSANET protocol and connect to the IEP 3705, and the other part of the bandwidth could provide provide an X25 or SDLC interface to NPSI or NCP running in a second communications processor.

2.3.2 Connecting a User Terminal or SHARP APL/PC System

The majority of network users have asynchronous terminals, connect via telephone dial-up, and use the system interactively. But many variations are possible. We recommend that you discuss your requirements with us **before** ordering any equipment; prior discussion is essential if you wish to connect to IPSANET by leased lines of any type. Telephone and Telex numbers used to access IPSANET are given in the workspace `1 NETWORK`.

- INTERACTIVE USE

  Asynchronous terminals. There are many varieties of asynchronous terminal, or devices emulating an asynchronous terminal; some current examples are:

  Hard copy printing terminals

  Display screens

  Personal computers including the IBM Personal Computer with I.P. Sharp PC products

  Word processors

  Minicomputer systems

  Mainframe computers, with or without SHARP APL systems.

  The available connection methods for asynchronous terminals are:

  Dial-up: over the telephone network using modems, data sets or acoustic couplers.

  Advantages—Readily and instantly available at nearly all locations served by IPSANET or public data networks. Low cost, especially for the less frequent user, and in areas where local telephone calls are free.

  Disadvantages—In some areas, poor quality in the local telephone service can introduce character errors.

  Directly connected via leased line: a dedicated telephone line connection between the terminal location and the nearest network node, using modems.

  Advantages—If telephone calls are charged by duration, this may be the cheaper method if your terminal is connected for several hours each day. Sometimes the line quality is better than with dial-up.

  Disadvantages—Requires several weeks or months between ordering and installation. More expensive for the infrequent user.

On site Alpha node: the best solution for four or more terminals at a single location.

Advantages—Eliminates character errors. Network connection is monitored and maintained by I.P. Sharp to the same standards as the public part of IPSANET. Dial-up ports can be provided for connection to internal telephone systems, in addition to hard wired direct connections.

Public network access: dial-up and directly connected terminal services are usually available.

Advantages—Public network access is most useful in cities where IPSANET does not yet have local access.

Disadvantages—Connection procedures are sometimes difficult, both for initial enrolment and for the dialogue at the start of each session. At best, the quality of service is comparable to direct connection to IPSANET; it can be very much worse. Service not available everywhere.

Telex terminals.

Any telex terminal anywhere in the world can be used for dial-up connection to IPSANET via the IPSANET telex gateways in Amsterdam and Rochester, New York. Telex is a switched, digital service with a limited speed and character set. See section 5.

IBM 3270 Information Display Systems.

Connection of a 3274 cluster controller or a 3276 integral controller to the network is possible. A leased line to the nearest IPSANET node plus additional interfacing hardware is required. The 3270 controller must be added to the network configuration of the system to be accessed. For further details see section 6. The line protocol used is SDLC or X25.

- BATCH USE

Data can be transferred to or from a file on one SHARP APL system in batch mode, at substantially lower character charges. There are several alternatives for the device at the other end of the call:

Another SHARP APL system attached to the network.
A lineprinter attached to an Alpha node.
A magnetic tape drive attached to an Alpha node.
A device emulating IBM 2780 or 3780 binary synchronous (bisync) devices, connected to an Alpha node either hard wired or by dial-up, including an IBM 6670 Information Distributor.

More details can be found in section 4.

2.4 COST OF USING IPSANET

Equipment and Lines

You are normally responsible for all the equipment on your premises, which includes the terminal, modem, acoustic coupler, telephone, or on-site Alpha node. If you connect to IPSANET or a public data network by dial-up, then you pay the cost of the call. If you are connected to the network by a leased line, then you are responsible for the costs of the line, and the equipment at both ends of the line which is dedicated to your use.

Call Charges—Timesharing

If you connect to the I. P. Sharp timesharing system there is, with only one exception, no additional charge for the use of the network above and beyond the character and connect charges that are incurred by use of the timesharing system as specified in your contract. This applies whether you connect to IPSANET directly, or through a dial-up connection to a public data network in the same country as the gateway between that network and IPSANET. Thus use of Telenet or Tymnet in the USA is free, as is use of Datex-P in Germany, and so on. The one exception is if you use a public data network to make an international connection, for example connecting into Telenet from Brazil, in which case you also pay locally the Brazilian share of the public network call charges, though I.P. Sharp does pay for the part of the costs incurred in the IPSANET gateway country (the Telenet costs in the USA, in this case). These foreign costs, where known, are listed in `1 NETWORK`.

Call Charges—In-House

If you use IPSANET to connect to an distributed system then there is a character charge based on the location of the distributed system and the location of your connection to IPSANET. These are listed in the distributed system price schedule. If your terminal is connected directly to a private node (Alpha or 3705 servicing the distributed system site) you are not considered to be a user of IPSANET for the purpose of calculating charges. In addition, if you connect through a public data network into IPSANET via one of the gateways, then there is a surcharge independent of the source of the call. Any foreign charge element of international public network calls also has to be paid locally by you, the same as for connection to the timesharing system.

3. PROCEDURES FOR ASYNCHRONOUS TERMINAL USERS

3.1 TERMINAL ADJUSTMENTS

The following requirements apply to all terminals that are connected to IPSANET by telephone dial-up, or by hardwired connections with or without modems, data sets or acoustic couplers. This includes micro computers, word processors, and other intelligent systems which are performing terminal emulation.

Requirements for the terminal:

ASYNCHRONOUS operation.

CHARACTER SETS: ASCII without APL character set (64 or 96 characters, also called TTY), ASCII with APL character set (typewriter paired or bit paired), IBM 2741 equivalent (EBCD or correspondence code).

Normally set for half-duplex operation, with the terminal providing local copy of all input. Operation in full-duplex (echoplex) mode is also possible, see section 3.5.

SPEEDS SUPPORTED: ASCII terminals (with or without APL) at 1200 or 300 bits/second (120 or 30 characters/second, IBM EBCD or correspondence terminals at 300 or 134.5 bits/second (30 or 15 characters/second).

Not all speeds are supported at all access locations, but if 300 bits/second is available, this includes the lower speed via the autospeed mechanism.

WORD LENGTH: Each character sent from the system to an ASCII terminal is transmitted with:

1 start bit
7 data bits
1 even parity bit
1 stop bit.

Therefore an ASCII terminal should be set to receive even parity, 1 stop bit. The terminal should preferably transmit data with the same format, but the received parity bit is discarded, so operation with no parity and two stop bits, or either parity with one or two stop bits may be successful, unless there are error correcting modems or other intelligent devices between the terminal and IPSANET connection.

Each character output to an IBM EBCD or correspondence terminal is transmitted with:

1 start bit
6 data bits
1 odd parity bit
1 stop bit.

Input parity is ignored.

Requirements for the modem, data set or acoustic coupler:

If the connection between the terminal and the network node is via dial-up or a hardwired link which uses modems, then the requirements for the modem are as follows:

ASYNCHRONOUS.

FULL DUPLEX communication. Although the system superficially appears to be half duplex (either input or output is in progress at any one time, never both simultaneously), break and flow control (XOFF/XON) both require full duplex communication.

SPEED to match the terminal.

MODEM TYPES that are used vary according to local circumstances, but normally acceptable are

In North America
- Bell 103 or similar
- Bell 212 or similar
- Vadic 3400 or similar

In Europe
- CCITT V21
- CCITT V22

3.2 SIGN-ON PROCEDURES

This is the procedure to be used if you are connecting directly into an IPSANET node. There are additional instructions to be followed if you are connecting through a public data network (such as Telenet), or through Telex, which are described in the I.P. Sharp factsheet *Sign-on Procedures*. The procedure given here applies equally for accessing the timesharing or distributed systems.

1. Turn terminal on.

2. Step 2 is only applicable if you are dialling your connection to IPSANET; otherwise proceed to step 3.

   If your terminal is connected to a modem (data set), make sure the terminal is in 'COMM' or 'REMOTE' mode. Then pick up the telephone receiver and push the 'TALK' button. When you hear the dial tone, dial the IPSANET local access number in your area. Upon hearing the high pitched tone, press the 'DATA' button on the telephone.

   If your terminal is connected to a coupler, place the terminal in 'LOCAL' mode, dial your local access number and when you hear the high pitched tone, place the receiver in the coupler. Make sure the cord is at the end marked 'CORD'. Then put the terminal in 'COMM' or 'REMOTE' mode.

3. If you want to connect to the **I.P. Sharp timesharing system**, you will normally type the letter *O* and a right parenthesis—'*O*)', then hit carriage return. This will give you a security **blot**. If there is no response after two seconds, repeat step 3. You may receive a network message instead of a blot: these messages are explained in section 3.7.

Optionally, if you wish to operate in Echoplex mode (what you type will be echoed back to you by the IPSANET node), then instead of '*O*)', type '*OE*)'. Alternatively, if you have a personal computer or word processor, and want to transfer large quantities of data to the mainframe system, or if you have a display terminal operating in full screen input mode, you may require Bulk Input mode, in which case you start by typing '*OB*)'. Sections 3.5 and 3.6 describe these options in more detail.

If you want to connect to a **distributed system**, then type the **network address** of the distributed system after the right parenthesis and before the carriage return. A network address is three or four alphanumerics which identify that mainframe. For example, suppose the network address of the system you want is 'WIDG', then the first line you type will be:

O)*WIDG* for normal use,
OE)*WIDG* for echoplex operation (section 3.5), and
OB)*WIDG* for bulk input operation (section 3.6),

in each case followed by a carriage return.

4. After receiving a security blot, enter another right parenthesis, your sign-on number, a colon and your password:

```
)1234567:PASS
```

then hit carriage return.

5. If you have signed on correctly, the mainframe will respond with the task identifier, time, date, sign-on name, and the name of the service to which you have connected.

3.3 CHARACTER SET

The I.P. Sharp system recognises your terminal to be one of five different types, as determined by your sign-on. This type is visible in `2 ⎕WS 3`. One type identifies normal ASCII terminals without an APL character set which may have either a restricted set with upper case alphabetics only, sometimes called TY33, or a full set including lower case alphabetics. The other four types are different varieties of APL terminal whose character sets include the APL graphics.

Each terminal type uses a different set of terminal transmission codes to represent the characters that it can display; these transmission codes are received or transmitted by the I.P. Sharp system, and are available to you from your program through ⎕*ARBIN* and ⎕*ARBOUT*. Although terminals connected directly by leased line or dial-up to IPSANET ports can send or receive all transmission codes, some loss of data transparency often occurs if the terminal is connected to IPSANET indirectly. Indirect connections include public data networks, statistical multiplexers, and error correcting or encryption devices. These devices or networks often assign certain transmission codes for control purposes, such as for flow control. ASCII users of indirect connections to IPSANET are particularly advised to avoid sending or receiving these transmission codes as normal data:

code 16 DLE, control-P
code 17 DC1, XON, control-Q
code 19 DC3, XOFF, control-S.

The normal internal character set of the I.P. Sharp system is called □*AV*, and this includes entries for composite characters normally formed by overstrikes; normal input and output includes a translation between □*AV* and an available graphic in your terminal's character set. Thus, □*AV*[86] is 'A' (upper case letter) on an ASCII terminal and '*A*' (letter in the APL alphabet) on an APL terminal, but note that □*AV*[113] is 'a' (lower case letter) on an ASCII terminal and '*a*' (letter with underbar) on an APL terminal. Also certain graphics from standard ASCII terminals are translated into particularly useful APL □*AV* values even though they are not graphically similar, and some more can be constructed by overstrikes: these are listed following the table. The APL terminal transmission codes and □*AV* values are described in the *SHARP APL Reference Manual*, chapters 9 and 10, in the *SHARP APL Pocket Reference,* and in the workspace 1 *ARBOUT*.

The following tables give the terminal transmission codes and □*AV* values for normal ASCII terminals without an APL character set.

ASCII Terminal Transmission Codes

	TCC Graphic	□*AV*		TCC Graphic	□*AV*		TCC Graphic	□*AV*		TCC Graphic	□*AV*
0	**NUL**	0	32	**SP**	152	64	**&**	22	96	**`**	65
1	**SOH**	-	33	**!**	48	65	**A**	86	97	**a**	113
2	**STX**	-	34	**"**	151	66	**B**	87	98	**b**	114
3	**ETX**	-	35	**#**	28	67	**C**	88	99	**c**	115
4	**EOT**	-	36	**$**	4	68	**D**	89	100	**d**	116
5	**ENQ**	-	37	**%**	29	69	**E**	90	101	**e**	117
6	**ACK**	-	38	**&**	45	70	**F**	91	102	**f**	118
7	**BEL**	-	39	**'**	153	71	**G**	92	103	**g**	119
8	**BS**	158	40	**(**	16	72	**H**	93	104	**h**	120
9	**HT**	-	41	**)**	17	73	**I**	94	105	**i**	121
10	**LF**	159	42	*****	30	74	**J**	95	106	**j**	122
11	**VT**	-	43	**+**	26	75	**K**	96	107	**k**	123
12	**FF**	-	44	**,**	47	76	**L**	97	108	**l**	124
13	**CR**	156	45	**-**	27	77	**M**	98	109	**m**	125
14	**SO**	-	46	**.**	150	78	**N**	99	110	**n**	126
15	**SI**	-	47	**/**	19	79	**O**	100	111	**o**	127
16	**DLE**	-	48	**0**	140	80	**P**	101	112	**p**	128
17	**XON**	-	49	**1**	141	81	**Q**	102	113	**q**	129
18	**DC2**	-	50	**2**	142	82	**R**	103	114	**r**	130
19	**XOFF**	-	51	**3**	143	83	**S**	104	115	**s**	131
20	**DC4**	-	52	**4**	144	84	**T**	105	116	**t**	132
21	**NAK**	-	53	**5**	145	85	**U**	106	117	**u**	133
22	**SYN**	-	54	**6**	146	86	**V**	107	118	**v**	134
23	**ETB**	-	55	**7**	147	87	**W**	108	119	**w**	135
24	**CAN**	-	56	**8**	148	88	**X**	109	120	**x**	136
25	**EM**	-	57	**9**	149	89	**Y**	110	121	**y**	137
26	**SUB**	-	58	**:**	154	90	**Z**	111	122	**z**	138
27	**ESC**	-	59	**;**	18	91	**[**	14	123	**{**	83
28	**FS**	-	60	**<**	36	92	****	20	124	**|**	33
29	**GS**	-	61	**=**	38	93	**]**	15	125	**}**	82
30	**RS**	-	62	**>**	40	94	**^**	34	126	**~**	54
31	**US**	-	63	**?**	53	95	**_**	21	127	**DEL**	-

Characters in this table with graphics shown as 'NUL' and so on, represent ASCII control codes; those which do not have equivalents in □*AV* are marked '-' in the □*AV* column.

The ASCII characters which are converted into □*AV* values representing dissimilar APL graphics, together with those elements of □*AV* which can be sent or received at ASCII terminals by means of overstrikes, are listed below.

APL graphic	□*AV*	ASCII graphic or overstrike	Meaning
$	4	$	dollar (National Use character)
←	21	_	left arrow
→	22	&	right arrow
×	28	#	times
÷	29	%	divide
∧	34	^	and
≠	41	= /	not equals
⍴	42	&	rho
⍞	65	'	quad
⎕	66	' '	quote quad
⌿	74	/ -	slash bar
⍀	75	\ -	slope bar
⌹	76	' %	domino
◇	79	< >	diamond
⊣	80	-)	right tack
⊢	81	(-	left tack
¯	151	"	overbar

3.4 PROTOCOL RULES, FLOW CONTROL

- READY FOR INPUT:

  The system signals the terminal that it is ready to receive further input by sending a BELL to ASCII terminals unless *PTRDR* mode has been enabled. *PTRDR* changes the 'ready for input' prompt to XON. This function can be found in the workspace 1 *WSFNS*. *PTRDR* doesn't work for IBM terminals, where the ready for input signal is the unlocking of the keyboard.

- END OF INPUT:

  The terminal must always signal the end of a line with carriage return. After sending a carriage return, no more input may be transmitted until a 'ready for input signal has been received.

- INPUT BUFFER LIMITS:

  No line of greater than a system dependent number of characters may be sent to the system in a single input. The limit for the I.P. Sharp timesharing system is currently 4000. Check with the installation systems programmer for input limits on other systems. If the limit is exceeded the system will discard the whole line and return RESEND. Bulk input (section 3.6) provides one method of avoiding this limit.

- FLOW CONTROL:

  XOFF (also called DC3 or 'transmitter off') from ASCII terminals causes the network to suspend output to the terminal and will maintain the output in suspension until either receipt of an XON (also called DC1 or 'transmitter on') or break. If break is signalled while output is suspended by XOFF, the network treats it as if the terminal had signalled XON followed immediately by break.

The network may send XOFF and XON to the terminal during input if the network is unable to forward input data onto the mainframe system. If the terminal violates input flow control the system will signal a RESEND upon turn around.

The character codes for XOFF and XON should always be avoided as input or output data, as they may be interpreted as flow control by other devices outside IPSANET. This is particularly important if the connection between your terminal and the network node passes through a statistical multiplexer, error correcting modem, or public data network.

- BREAK:

If break is transmitted from an ASCII terminal while the system is in output mode, the network will stop transmitting and discard any queued output. If break is transmitted after the terminal has turned the line around and the system is processing or waiting for some process to complete the system will get an attention signal and attempt to interrupt the processing and turn the line around. If break is transmitted while the system is accepting input from the terminal the system discards any input received and reissues a prompt. For a detailed description of the system's treatment of break see the *SHARP APL Reference Manual.*

The ASCII character ETX (control C) will be treated as break if it is input from the terminal while the system is processing or during output. During input ETX will be forwarded to the system as data.

ATTENTION from an IBM 2741 terminal is interpreted in the same way as break from an ASCII terminal.

- IDLES CALCULATION:

For some terminal types and speeds, the system automatically inserts idles into the output after every carriage return, to allow time for unbuffered printing terminals to be ready for the next line. The idles character for an ASCII terminal can be either NUL or DEL (0 or 127), according to the `)TERM` setting. Further details of the idles calculation, and how to suppress idles if not required, are given in the workspace `5 TERM`. For 120 characters/second terminals, the default state now has no automatic insertion of idles.

3.5 ECHOPLEX

If there is a modem link between your terminal and the network node, character errors may be introduced by this link. Character errors on output from the system can be simply detected by setting the terminal to verify the parity of received data. In the default state for an ASCII terminal, in which the terminal produces local copy internally, character errors on input to the system may go undetected and the data received by the system may differ from that displayed on the terminal. A check on the input received by the system can be made by switching off the local copy at the terminal and switching on an echoing of all input by the network node. This is called echoplex operation: every character you type will be sent back to you by the network node after a short delay. There is no additional charge.

If your terminal is connected to an IPSANET node, you switch on echoplex by typing an '*E*' between the '*O*' and the ') of your initial input at sign on. You should also switch the terminal to 'FULL DUPLEX' else you will receive two copies of each typed character.

If your terminal is connected to a public data network conforming to international standards, you can also switch on echoplex from that network. In that case, you should still use *O*) (no '*E*') in your IPSANET sign on, as additional echoplex from IPSANET is likely to be meaningless or very confusing. Most public networks use PAD parameter 2 to control echoplex, with the values of 1 for echoplex and 0 for no echoplex. To switch on echoplex when accessing via a public network, use

PSET 2:1	from a ASCII terminal without APL
P⌈∈~ 2(1	from an APL terminal

where **P** represents control-P (hold down the 'CTRL' key while typing 'P'). In some networks, echoplex is the default state. In non-standard networks, there may be some other means of activating echoplex.

3.6 BULK INPUT

Users connecting to Alpha nodes on IPSANET can make use of bulk input, which allows input to be of unlimited size and to be terminated by any character and/or by a timeout. The timeout can be disabled before the first character is transmitted to allow a set-up time.

Since this facility requires some special code sequences to be sent from the system which are interpreted by the network and not delivered to the terminal, you must signify to your local node that you wish to use bulk input by signing on with the sequence *OB*) in place of *O*) or *OE*). Bulk input precludes use of echoplex. The terminal must accept flow control by XOFF/XON.

The workspace 5 *BINP* describes the feature in more detail.

3.7 NETWORK MESSAGES

3.7.1 Network Messages—Timesharing

Messages produced by IPSANET may be received by you in two circumstances: either when trying to connect to an APL system if that connection cannot be completed, or while connected to an APL system if that connection has to be terminated unexpectedly.

The network messages which you may receive while attempting to connect to the I.P. Sharp timesharing system are:

NO PATH

This message has two meanings. Usually this indicates that at the instant when the initial 'O)' line was processed, there was no available route through the network from your terminal to the I.P. Sharp timesharing system; this indicates a temporary network problem. The best action is to try again to connect; if that attempt also fails, try again in a few minutes or call I.P. Sharp for advice. This message would also be received if you typed three or four characters between the 'O)' and the carriage return, and these characters did not match the network name of an accessible distributed system. Your telephone call will be disconnected after 20 seconds of inactivity.

APL DOWN /+++

There is a route through the network to the I.P. Sharp timesharing system, but that system is not available to you. Either it is during the weekly maintenance shut-down, or the system is temporarily broken. Your call through the network to the timesharing system remains connected; typing carriage return again will force another attempt at connection, which will produce a blot if the system is now available. The characters which appear instead of '+++' contain additional diagnostic information, for the benefit of the operators of the system and network.

APL FULL /+++

Like 'APL DOWN' this message indicates that you have connected through the network to the I.P. Sharp timesharing system, but the system is currently being used by the maximum number of users and there is no room for you. Try again; if this message is received several times, call I.P. Sharp for further advice.

The following messages could be received any time after connecting to the system.

LINES DOWN

Your path through the network has been broken by a network problem. If you were signed on to APL, your workspace will have been automatically saved, and you will have been logged off. You can try to sign on again immediately, starting with the 'O)' line, since the route you were using may already have been repaired, or there may be an alternative route available. If you do nothing for 20 seconds after receiving this message, your telephone call will be disconnected and you will have to re-dial.

APL RESET /+++

The APL system crashed or was stopped. The system operators will be attempting to restore service as quickly as possible, but that will take several minutes if there are hardware problems, or if the crash recovery programs have to be executed for a large number of users. Your connection to the system remains, and an attempt to sign on again will either get the 'APL DOWN' message or a blot.

3.7.2. Network Messages—Distributed Systems

Suppose you want to connect to a I.P. Sharp APL system operated by The Widget Company, who have chosen the network address 'WIDG'. Messages produced by IPSANET may be received by you in two circumstances: either when trying to connect to an APL system if that connection cannot be completed, or while connected to an APL system if that connection has to be terminated unexpectedly.

The network messages which you may receive while attempting to connect to The Widget Company's system are:

NO PATH

This message has two meanings. Usually this indicates that at the instant when the 'O)WIDG' line was processed, there was no available route through the network from terminal to The Widget Company's system; this indicates a temporary network problem. The best action is to try again to connect; if that attempt also fails, try again in a few minutes or call I.P. Sharp for advice. This message would also be received if you mis-spelt the network name 'WIDG'. Your telephone call will be disconnected after 20 seconds of inactivity.

WIDG APL DOWN /+++

There is a route through the network to the Widget system, but that system is not available to you, either because it is during a scheduled shut-down, or the system is temporarily broken. Your call through the network to the Widget system remains connected; typing carriage return again will force another attempt to obtain a blot, which will succeed if the system is now available. The characters which appear instead of '+++' contain additional diagnostic information for the benefit of the system and network operators. If you require more information about the probable duration of the outage, contact the Widget data centre.

WIDG APL FULL /+++

Like 'WIDG APL DOWN', this message indicates you have connected through the network to the Widget system, but the system is currently being used by the maximum number of users and there is no room for you. Try again; if this message is received several times, call the Widget data centre for further advice.

The following messages could be received at any time after connecting to the system:

LINES DOWN

The path of your call through the network has been broken by a network problem. If you were signed on to APL, your workspace will have been automatically saved, and you will have been logged off. You can try to sign on again immediately, starting with the 'O)WIDG' line, since the route you were using may already have been repaired, or there may be an alternative route available. If you do nothing for 20 seconds after receiving this message, your telephone call will be disconnected and you will have to re-dial.

WIDG APL RESET /+++

The Widget APL system crashed or was stopped. A recovery and restart of the system may take several minutes. Your connection to the system remains and an attempt to sign on again will either get the 'WIDG APL DOWN' message or a blot.

4. REMOTE BATCH (RJE) SERVICES

The network background file transfer protocol communicates with a special APL task called an R-task in the APL system at one end of the call. At the other end of the call, a number of different devices are supported. Full details are given in the *Bisync Users Manual.*

For dial-up connection, devices emulating IBM 2780 or 3780 are supported. These are single user, Binary Synchronous (Bisync) systems, not HASP. The 2780 or 3780 device **must** be able to start the transmission by bidding to transmit and also transmit an initial file containing sign-on information, such as a valid user number and lock. Dial-up access is provided to the I.P. Sharp timesharing system only, except by special arrangement. Special dial-up lines and modems are used.

Bisync devices may also be hardwired (directly connected) to an Alpha node, which need not be adjacent. Other conditions are the same as for dial-up connection, except that access to any system on the network is possible, and although the device must make the first transmission, it is sufficient to transmit an empty file with no data. An IBM 6670 Information Distributor is such a device which can be hardwired to an Alpha node, providing high quality laser printing on standard paper.

The Alpha node can also be configured for local attachment of a lineprinter or magnetic tape drive. Suitable lineprinters are made by Mannesmann Tally and Okidata. The magnetic tape drive and controller is manufactured by Kennedy. Either or both of these can be connected to one Alpha. Control of the operation is locally through the Alpha console, or, in some cases, remotely.

Space compression is applied to all R-task transmissions in both directions, thus minimising the transmitted character counts. R-task traffic has a lower priority than interactive terminal traffic. The character total after compression is used for billing, and normally the rate per character is half that of the applicable character charge for interactive terminals connecting to the same system from the same location.

5. TELEX ACCESS

Telex connects dial-up teleprinter terminals over a slow speed digital network which does not carry voice traffic. The main advantage of telex is its world wide availability. It offers lower cost and better quality than telephone dial-up over similar distances. The disadvantages are:

- slow speed, less than 7 characters per second
- very limited character set
- narrow print width.

Therefore telex is best used in high value applications, and with applications software that has been specially tailored to overcome the deficiencies of the telex system. Since telex terminals often have paper tape readers, any quantity of data to be sent to the system is best prepared on paper tape in advance, and given a preliminary check, before transmitting it to the I.P. Sharp system; the IPSANET telex gateways allow for continuous input using paper tape.

The IPSANET telex gateways are in Amsterdam, The Netherlands and Rochester, New York, USA.

Applications programmers writing telex applications and users of these applications are advised to read the I.P. Sharp *Telex User Manual.*

6. 3270 TERMINALS

IPSANET can support 3270 terminals in a variety of ways, and the best option for a particular user is considerably dependant on the system to which access is required, the volume of traffic, the number of terminals, and the distance. The connection to the SHARP APL system is always through VTAM and SAPV or IDSH.

One method is to use IBM's X25 protocol implementation for support of SNA devices through public data networks. Multiple remote 3274 cluster controllers may be connected by a single physical link to the mainframe system. The requirements for this option are:

At the terminal end:

1. an IBM 3274 cluster controller with SDLC line protocol connected through an IBM NIA (Network Interface Adapter) which converts SDLC to X25. Alternatively a 3274 with Configuration Support P provides a direct X25 interface.
2. a leased line to an IPSANET Alpha node which has been specially configured for X25 support.

At the mainframe system end:

3. a connection between an IPSANET Alpha supporting X25 and an IBM 3705 front end processor running NCP (Network Control Program) software with NPSI (Network Packet Switching Interface). See Figure 4.

Configuration required:

4. a VTAM configuration including the remote terminal
5. an IPSANET configuration including the link.

Another option is to provide a single path through IPSANET which communicates via SDLC line protocol at each end. The VTAM and NCP configurations are the same as if the 3274 was connected by a dedicated line. See Figure 5. Further details are obtainable from the I.P. Sharp communications department on request.

Figure 4
3270 Support with NIA

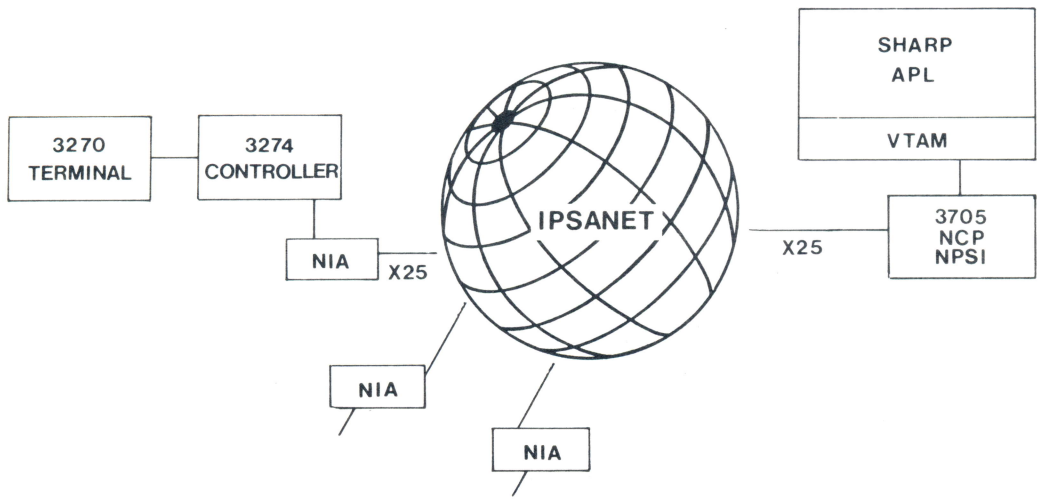
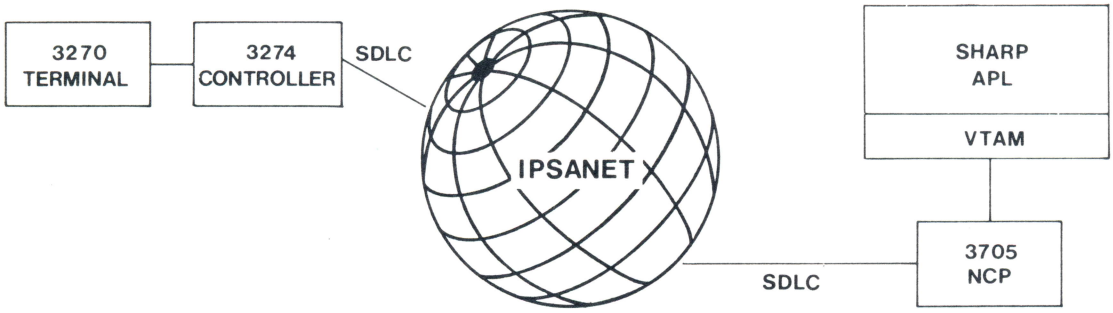


Figure 5
3270 Support with SDLC



7. ERROR CORRECTING MODEMS

In a few cities, identified in 1 *NETWORK*, the 120 cps dial-up access numbers are provided with error correcting modems. If your modem includes a matching error corrector, or if a stand-alone error corrector is used with an existing modem, then it is possible to eliminate all character errors introduced by line noise.

If you plan to use error correction, local contact with I.P. Sharp is essential to ensure that compatible equipment is obtained. Furthermore, the presence of error correction at the I.P. Sharp end of the link requires all terminals using those access numbers to operate with 7 data bits and even parity, even if there is no error corrector at the terminal end. Error correction only takes place if both ends are suitably equipped, and a degradation in performance may be seen if the line is particularly poor requiring the correction of many errors.

Error correction is currently available in London, Coventry, Birmingham, and Warrington, England, and in Aberdeen, Scotland.

8. PUBLIC DATA NETWORKS

Public data networks offer a variety of services within the countries in which they operate. These include dial-up and leased line services for the connection of asynchronous terminals. They also provide links using X25 protocol for the connection of host computers. The networks are themselves interconnected, both to other public data networks and to gateway nodes located in other countries. IPSANET is directly connected by X25 links to seven public data networks:

Country	Network	Host Address
Canada	Datapac	3020 79100020
France	Transpac	2080 75060105
Germany	Datex-P	2624 5211040130
Switzerland	Telepac	2284 47911023
United Kingdom	PSS	2342 19200203
United States	Telenet	3110 7160005000
United States	Tymnet	3106 0155

Users in those countries where there is a direct connection can connect through the public network to the gateway node in that country. Many other countries have public data networks or gateways which interconnect with one or more of those seven networks: workspace `1 NETWORK` lists some of the possibilities. Users of the foreign networks can connect to I.P. Sharp using the most convenient of those gateways.

Sign-on procedures differ in each public data network; some of the local procedures are given in `1 NETWORK`. In other countries, contact the operators of the public data network for enrolment and sign-on information. At the start of each network call, an additional one to four lines of input is required before the connection to I.P. Sharp is properly set up.

Echoplex from IPSANET is not useful for public network users, but equivalent echoplex operation can usually be provided by adjusting local PAD parameters (terminal control parameters). The I.P. Sharp system potentially provides most of the device control that can also be provided by the PAD; the PAD parameter setting which most nearly correspond to the default behaviour of IPSANET are:

Parameter	Value	Meaning
1	1	Escape from data transfer on
2	0	Echo off
3	2	Forward on carriage return only
4	0	No timeout
5	1	Ancilliary device control on
6	1	Allow PAD service signals
7	21	Send break
8	0	Transmit data
9	0	No padding after carriage return
10	0	No line folding
11	-	(Speed)
12	1	Flow control on
13	0	No line-feed insertion
14	0	No padding after linefeed.

Pub. Code: 0239 8403 E1